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Technical note

Microendoscopic discectomy (MED) for lumbar disc prolapse

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Summary Microendoscopic discectomy (MED), which combines traditional lumbar microsurgical techniques with endoscopy, is being used as a minimally invasive procedure for lumbar disc herniation. We reviewed 30 patients who underwent MED at our institution and compared their outcome with that of patients subjected to the conventional method. Laboratory data suggested that MED was less invasive surgery. Moreover, MED allowed an early return to work. However, the difficulties of this endoscopic procedure were evident, because of the limited exposure and two-dimensional video display. The potential injury of the nerve root and prolonged surgical time remain as matters of serious concern. To overcome this problem, we used an operative magnifying glass during surgery and this helped us to accomplish the procedure comfortably. We recommend the use of an operative magnifying glass in the early stage of the introduction of MED, for it is quite useful to identify the three-dimensional relationships of the structures.

Keywords: microendoscopic discectomy, lumbar disc herniation, minimally invasive surgery, operative magnifying glass

INTRODUCTION

Microendoscopic discectomy (MED) was introduced as a minimally invasive procedure for lumbar disc herniation by Foley and Smith in 1997.[1]

This is the endoscopic posterior approach procedure; the herniated tissue is resected endoscopically via a tubular retractor (16 or 18 mm in diameter). The endoscopic posterior approach allows a smaller incision and less tissue invasion than the standard open microdiscectomy. The replacement of subperiosteal muscle stripping with the small muscle-splitting approach is expected to make a marked reduction in postoperative pain and muscle spasm.

However, there have been few reports regarding the extent of surgical invasion with this procedure in the English literature.

On the other hand, the difficulties of this endoscopic procedure are evident, because of the limited exposure and two-dimensional video display. The potential injury of the nerve root due to the limited working space and field of vision remains a serious concern.

We have used MED instead of the conventional Love's procedure[2] since March 2000. However, in the early stage after the introduction of MED, we spent a long time in the operation and blood loss was significant, because of the difficulties encountered in identifying the three-dimensional relationships among the bony structures, yellow ligament, nerve root and herniated tissue under the limited field of vision and on a two-dimensional video display. To overcome this problem, we used an operative magnifying glass and this helped to accomplish the surgery comfortably.

The aim of the present study was to evaluate the efficacy of using an operative magnifying glass for MED and to investigate surgical invasion and the short-term results of MED as compared with the conventional Love's method.

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PATIENTS AND METHODS

We reviewed 30 patients who underwent MED at our institution from March 2000 to October 2001 (MED group) and 30 consecutive patients subjected to Love's method before March 2000 (Love group). All 60 patients were followed up for at least 16 weeks. In all of them, surgery was performed by the first author and MED was performed using the METRx™ system (MEDTRONIC SOFAMOR DANEK, Memphis, TN).

The demographic data are presented in Table 1.

All patients presented with painful sciatica that was refractory to conservative treatment which had included bed rest, non-steroidal anti-inflammatory medication, epidural blocks and selective nerve root blocks and compression of the involved nerve root was confirmed by imaging studies.

Patients with previous back surgery and those who presented only with lower back pain without sciatica were not included in this study.

The JOA score (Japanese Orthopedic Association's evaluation system for lower back pain syndrome) was determined before surgery and at each follow-up visit, to assess subjective symptoms, clinical signs and restriction of ADL. The normal score is 29 points (Table 2). The recovery rate of the JOA score was also calculated at each follow-up visit as described by Hirabayashi et al.[3]

$$\text{Recovery rate}(\%) = \frac{(\text{Postoperative score} - \text{Preoperative score})}{(29 - \text{Preoperative score})} \times 100.$$

The intensity of surgical injury was estimated in terms of operative time, blood loss, laboratory data, postoperative body temperature (BT) and use of analgesics. Laboratory data, which included the serum level of C-reactive protein (CRP), white blood cell (WBC) count, creatine phosphokinase (CPK) and total protein (TP), were examined the day after surgery. The normal CRP and CPK value in our hospital was less than 0.3 mg/dl and 195 IU/l, respectively.

The period of return to work was compared between the 2 groups. We instructed patients to return to work when they were confident they could work again.

Table 1 Demographic data

	MED	Love
Sex (F/M)*	8/22	15/15
Mean age (range)*	42.9 (16–73) years	36.6 (17–65) years
Mean follow-up period (range)**	34.1 (16.2–81.3) weeks	69.5 (17.4–183.1) weeks

Male to female ratio was compared using χ^2 test. Age and follow-up period were compared using Student's unpaired *t* test.
* No significant difference.
** Significant difference ($p < 0.01$).

Table 2 The Japanese Orthopaedic Association's Evaluation System for Lower Back Pain Syndrome (JOA Score)

Evaluation and score			
Subjective symptoms			
Lower back pain	None	3	
	Occasional, mild	2	
	Occasional, severe	1	
	Continuous, severe	0	
Leg pain and/or tingling	None	3	
	Occasional, light	2	
	Occasional, severe	1	
	Continuous, severe	0	
Gait	Normal	3	
	Able to walk farther than 500 m although it results in symptoms[a]	2	
	Unable to walk farther than 500 m	1	
	Unable to walk farther than 100 m	0	
Clinical signs			
Straight-leg-raising test	Normal	2	
	30–70°	1	
	Less than 30°	0	
Sensory disturbance	None	2	
	Slight disturbance (not subjective)	1	
	Marked disturbance	0	
Motor disturbance	Normal	2	
	Slight weakness (MMT 4)	1	
	Marked weakness (MMT 3 to 0)	0	
Restriction of ADL			
	Impossible	Difficult	Easy
Turn over while lying	0	1	2
Standing up	0	1	2
Washing face	0	1	2
Leaning forward	0	1	2
Sitting (about 1 h)	0	1	2
Lifting or holding heavy object	0	1	2
Running	0	1	2
Urinary bladder function	Normal	0	
	Mild dysuria	−3	
	Severe dysuria	−6	

Recovery rate (%) = (Postoperative score − Preoperative score)/(29 − Preoperative score) x 100.
[a] Pain, tingling, and/or muscle weakness; MMT, manual muscle testing; ADL, activities of daily living.

STATISTICAL ANALYSIS

Statistical analysis was performed using Stat View 5.0 (SAS Institute, Cary, NC) and statistical significance was set at a *p* value of less than 0.05.

Differences in JOA score were assessed using Student's unpaired *t* test, before surgery and at final follow up; as well as between before and after surgery in each group using Student's paired *t* test. Differences in the recovery rate at each follow-up visit, operation time, amount of blood loss, duration of fever, the value of laboratory data and the period to return to work were also compared using Student's unpaired *t* test. The male to female ratio and the number of patients who needed analgesics after surgery were compared using χ^2 test.

SURGICAL CONTRIVANCE OF MED

To overcome the difficulties in identifying the three-dimensional relationships of the surgical field, we tried to directly visualise it through a tubular retractor; we then obtained a three-dimensional view, but did not obtain a magnified view. Therefore, we started using an operative magnifying glass to obtain a three-dimensional and clearly magnified view. After insertion of the tubular retractor, the partial resection of yellow ligament was carefully performed. The condition of the nerve root and the spatial relationship between the nerve root and herniated tissue were identified using the operative magnifying glass. The surgical field in the tubular retractor of 18 mm in diameter and 92-mm long was sufficiently in focus. It was easier to put on and take off the operative magnifying glass than to set-up an operating microscope. The combination of the magnifying glass view, video display and direct view through the tubular retractor was very useful, especially, in the early stages of the introduction of MED.

RESULTS

The overall results and the *p* values of differences between the 2 groups are given in Table 3.

JOA score significantly improved in each group after surgery ($p < 0.01$).

A significantly superior recovery rate was obtained within the first 16 weeks in the MED group. However, using a 15-point system for the JOA score, which does not include restriction of ADL, there was no significant difference between the 2 groups in the early stage (Table 4, Fig. 1).

Operation time of the MED group was quite long for the first 10 cases. In the last 20 cases, the mean operation time was 86.5 min and not significantly different from that in the Love group. We started to use the operative magnifying glass for the fifth case and used it in the following several cases. Thanks to the three-dimensional recognition of the structures using the operative magnifying glass, the procedure became speedy and the operative time was remarkably shortened (Fig. 2).

The duration of a peak BT over 37 °C was not significantly different.

The level of CPK of the Love group on Day 1 was significantly higher than that of the MED group ($p < 0.01$). The value of TP on Day 1 was significantly greater in the MED group ($p < 0.01$).

There was no significant difference in the dosage of analgesics (suppository of Diclofenac sodium) on the day and night after surgery. However, the number of patients who did not need analgesics after surgery was significantly greater in the MED group than the Love group (MED, 16 cases; Love, 7 cases) ($p = 0.0169$).

There were 22 company employees in the MED group, and 19 in the Love group. Twenty-one out of the 22 patients in the MED group were able to return to their work; 17 of them as early as 2 months after surgery. On the other hand, 13 out of the 19 patients in the Love group were able to return to their work, with only 3 patients being able to return to their work during the 2 months after surgery.

In the MED group, a 57 year old woman retired after surgery. In the Love group, a 56 year old woman and a 48 year old woman were not able to return to their previous work and retired. Two

Table 3 Overall results of each procedure

		MED[a]	Love[a]	*p* Value
JOA score	Preoperative	11.7 (4–23)	12.2 (3–21)	0.2933
	Final follow up	26.3 (18–29)	25.8 (18–29)	0.2813
Recovery rate (%)	Final	82.4 (−10.0 to 100)	79.1 (26.7–100)	0.2658
	~8 weeks	70.3 (7.9–100)	50.8 (37.5–63.6)	<0.01
	~12 weeks	80.8 (50.0–95.0)	51.1 (−15.4 to 84.6)	<0.01
	~16 weeks	82.9 (50.0–100)	64.8 (21.4–100)	0.0182
	~24 weeks	74.7 (45.0–100)	65.8 (−5.9 to 94.1)	0.2397
Operation time (min)		109.1 (49–225)	79.3 (30–188)	<0.01
Blood loss (ml)		92.9 (0[b]–700)	112.8 (0[b]–650)	0.3724
Duration of high fever (days)		2.0 (0–6)	2.5 (0–8)	0.2551
Level of CRP (mg/dl)		0.557 (0.3–3.15)	0.800 (0.3–0.4.77)	0.4107
WBC count (×1000)		87.4 (52.5–128.3)	87.9 (52.2–136.8)	0.1484
CPK (IU/l)		267.3 (79–740)	477.7 (108–852)	<0.01
Total protein (g/dl)		6.31 (5.7–7.1)	5.91 (5.2–6.8)	<0.01
Return to work (days)		49.2 (19–169)	85.9 (30–152)	<0.01

[a] The values are the mean, with the range in parentheses.
[b] It was too small to quantitate.

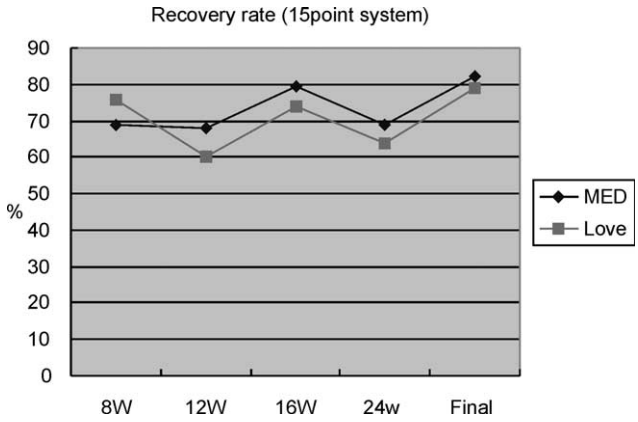

Fig. 1 Recovery rate determined based on the 15-point system between two groups. There was no significant difference at each follow-up period between the 2 groups.

women retired after surgery and married. A 28 year old man and a 25 year old man changed employment after surgery.

In the MED group, none of the patients was converted to the Love procedure, although asymptomatic root sheath tears occurred in 1 patient and 1 patient experienced superficial wound infection. A 31 year old man had a second attack of sciatica 18 months after the first surgery and was re-operated.

No surgical complications were encountered in the Love group.

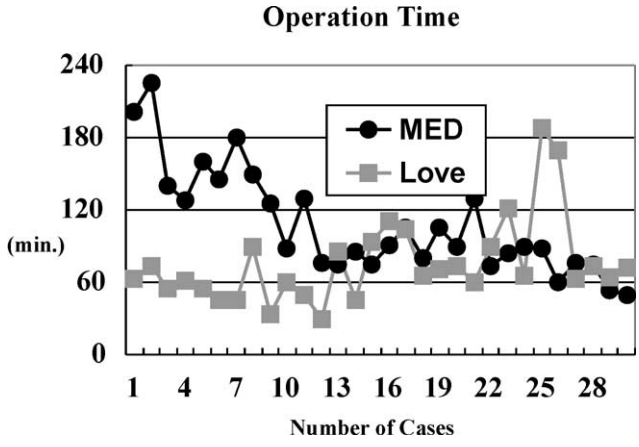

Fig. 2 Operation time in the MED and Love group. The operation time of MED became remarkably shorter after the first 10 cases. We started to use the operative magnifying glass on the fifth case and used it in the following several cases.

Table 4 Recovery rate of 15-point system

Recovery rate	MED (%)	Love (%)
~8 weeks	68.7	75.9
~12 weeks	67.8	60.2
~16 weeks	79.3	73.7
~24 weeks	69.0	63.9
Final	82.4	79.1

DISCUSSION

Sciatica caused by a lumbar disc herniation is the most common disease among the working population.

Surgery for lumbar disc herniation provides satisfactory results, however, conservative therapy is still the first-choice treatment for lumbar disc herniation.[4–10] Weber[8] mentioned that the results of surgical treatment were superior to conservative treatment at 1 year follow up but not significantly better at 4 years, however, at 10 years the outcomes of the 2 treatments were similar. In Atlas's study, although surgical treatment was associated with greater improvement than nonsurgical treatment at 5 years, the relative benefit of surgery decreased over time.[4]

Furthermore, the frequency of disappearance or a remarkable decrease in the size of lumbar disc herniation has been reported to be between 48 and 76%.[11,12] We emphasise the significance of an adequate period of conservative therapy before surgery because of the well known natural improvement of lumbar disc herniation.

Several surgical procedures for lumbar disc herniation are available. Posterior approaches such as Love's method,[2] microscopic discectomy[13] and posterior lumbar interbody fusion (PLIF), as well as anterior approaches and percutaneous approaches such as percutaneous nucleotomy (PN), percutaneous laser disc decompression (PLDD) and arthroscopic microdiscectomy, are widely performed.[14–18]

Sciatica is due to nerve root compression by a herniated disc (nucleus pulposus and annulus fibrosus). Theoretically, direct excision of the herniated disc is the best procedure. Consequently, Love's method has been an integral part of the procedures used in

spinal surgery for lumbar disc herniation since its introduction in 1939.[2]

Microscopic discectomy, as described by Caspar,[13] has permitted a less invasive approach than Love's method and it is associated with a faster patient recovery. However, the surgical invasion of the microscopic method is still great compared to percutaneous procedures. Invasiveness of the percutaneous procedures is quite small, although their indication is limited.[19,20]

Therefore, less invasive and versatile surgery following the posterior approach has been expected to overcome the limitations of the previous procedures.

Since March 2000, we have been using MED instead of Love's method for lumbar disc herniation. The previously reported clinical results of MED were almost satisfactory and comparable with those obtained with Love's method or microdiscectomy.[1,21,22] However, Muramatsu et al. reported that the operation time of MED was significantly longer, and Brayda-Bruno mentioned that the operation time diminished according to the learning curve.[21,22] We also spent a lot of time for the preparation of an acceptable surgical field. We found it difficult to estimate the condition of the nerve root, despite the magnified two-dimensional video display. Furthermore, because of the 25° angled scope, the assessment of the spatial relationship between the actual field and the image on the monitor screen was difficult for us.

To overcome this problem, at first we tried the combined use of a surgical microscope but found that the surgical devices and the surgeon's hands disturbed the fixed field of vision under the surgical microscope. Furthermore, the surgeon could not look through the tubular retractor because of the fixed microscope.

Next, we decided to use an operative magnifying glass. The combination of the two-dimensional video monitor and the three-dimensional magnifying glass view allowed us to obtain the adequate information regarding the surgical field. As a result, the operation became safer and more certain and the operation time was remarkably shortened.

After using the magnifying glass in several cases, we replaced the magnifying glass vision by direct vision. Currently, we do not use the magnifying glass routinely, the combination of the video monitor and direct vision is usually enough to perform the surgery. However, we encountered dural tears of the nerve root after operating on more than 20 cases. The risk of nerve root injury due to limited working space and image is still high with the MED procedure. Careful surgical technique is always required even for the experienced surgeon.

The endoscopic approach allows a smaller incision and considerable less tissue trauma than the standard Love's method and microdiscectomy. Muramatsu et al. concluded in their study using contrast-enhanced MRI imaging that MED was appreciably less invasive than Love's method with regard to the paravertebral muscles.[21] Using intraoperative electromyographic techniques, Schick et al. also mentioned that MED seemed to lead to less tissue trauma as compared to open microscopic surgery.[23] In the present study, significant differences in the CPK level observed on postoperative day 1 between the 2 methods were due to the difference in the extent of paravertebral muscle damage. Furthermore, the degree of the muscular injury might have influenced the decrease of TP on day 1. Our findings suggested that MED was less invasive than Love's method, and might have contributed to the significant high recovery rate obtained within the first 16 weeks after surgery.

Postoperative pain seemed to be lesser in the MED group than in the Love group.

There were no significant differences with respect to blood loss, operation time, duration of high fever, the level of CRP or WBC count in our study. Probably, because the number of patients in each group was too small.

We concluded that MED did not only require a small skin incision but it was also less invasive compared with Love's method.

Furthermore, MED allowed an early return to previous occupation. Return to work is largely governed by extraspinal factors.[24,25] However, in the present study, return to work was decided only by the patients, so we estimated that the early return to work in the MED group was one of the advantages of this procedure.

Although the significantly superior recovery rate obtained within the first 16 weeks might suggest the advantage of MED, the main factor affecting the recovery rate in the early stage was the restriction of ADL.

Therefore, we suspected that not only reduced invasion of back muscles, but also psychological factors associated with the small incision might account, at least in part, for the good results and early return to work.

A 31 year old man underwent a second surgery for recurrent radicular pain 18 months after MED. The pain-free interval of this case was more than a year. Reoperation has been reported in 6–20% of patients after spinal surgery.[26–29] There have been no reports of recurrent herniation after MED. We could not conclude whether recurrence was due to the surgical procedure in this case.

CONCLUSION

MED is less invasive compared with Love's method. We obtained good results. The disadvantage of this technique is the two-dimensional vision, as for any endoscopic surgery. We recommend the use of an operative magnifying glass in the early stage after the introduction of MED. It is quite useful to identify the three-dimensional relationships of the structure.

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